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Declaration

This work is original and has not been submitted in relation to any other degree of qualification.

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Abstract

Unhealthy eating habits and physical inactivity are major risk factors for poor health outcomes such as obesity (Body Mass Index, BMI $\geq 30\text{Kg/m}^2$), chronic diseases and all-cause mortality. Low sleep quality has also been found to be arising in recent years and in parallel with the global obesity epidemic crisis, and studies have also reported significant associations between poor sleep quality and increased cardiometabolic risk. An interrelationship between poor eating habits, physical inactivity and poor sleep quality/quantity has also been found, a phenomenon even more detrimental to health. The global phenomenon of migration, which is growing in scope; manifested in the increasing numbers of professionals and students in foreign countries, influences the health of individuals and populations. The challenge usually emanates from readjustment of the migrant or sojourner in the host city or nation, and alterations in certain modifiable lifestyles may accompany such readjustment process. Consequently, investigating the issues relating to health and welfare of individuals upon relocation, both domestic and international is a public health priority. This paper critically examines the influence of migration on dietary behaviours, physical activity, and sleep quality/quantity and their relation to health, and makes suggestions for future research.

LITERATURE REVIEW

1. Introduction

Unhealthy eating habits and physical inactivity are major risk factors for poor health outcomes such as obesity (Body Mass Index, BMI $>30\text{Kg/m}^2$), certain chronic diseases and all-cause mortality worldwide (Brunner et al., 2008; Kant, 2004; Loef & Walach, 2012; Warburton, Nicol, & Bredin, 2006). In recent years, low sleep quality has also been found to be arising in parallel with the global obesity epidemic crisis (Cappuccio et al., 2008; Nielsen, Danielsen, & Sørensen, 2011). The MORGEN Study showed that short sleep duration (≤ 6 hours) significantly increases the risk of total cardiovascular disease (HR: 1.15; 95%CI: 1.00-1.32) as well as coronary heart disease (HR: 1.23; 95%CI: 1.04-1.45), in comparison to normal sleep duration defined as 7 hours of sleep (Hoevenaars-Blom, Spijkerman, Kromhout, van den Berg, & Verschuren, 2011). The adverse effects of poor diet quality, physical inactivity and poor sleep are further amplified by their propensity to cluster (Chiolero, Faeh, Paccaud, & Cornuz, 2008; Santos, Ebrahim, & Barros, 2007), thus presenting a profound health, social as well as economic burden, and also significant implications for public health intervention in that, these lifestyles cannot be examined in isolation (Schuit, van Loon, Tijhuis, & Ocké, 2002). Despite their immense associated health benefits, an incontrovertible body of evidence suggests that national and global healthy eating (Imamura et al., 2015), physical activity (Hallal et al., 2012) and sleep (Soldatos, Allaert, Ohta, & Dikeos, 2005) recommendations are not being met by individuals on a global scale. The evolution of the modern environment over the past century from a 'traditional' to 'westernized' and mechanized one, characterized by increased availability of high calorie, nutritionally less dense foods and limited opportunities for physical activity typically mediates the poor dietary habits and sedentariness

observed among populations (Swinburn, Caterson, Seidell, & James, 2004). However, the causes of these behaviours are multifactorial, comprising a broader array of behavioural, physiological, socioeconomic and environmental factors (Wetter et al., 2001). Enhanced age, the female gender, snoring, ethnicity and concomitant health effects (Singareddy et al., 2012) as well as disruptions in the circadian rhythm (Zhu & Zee, 2012) and other environmental factors such as noise (Muzet, 2007) have all been identified as significant risk factors for poor sleep quality among populations.

Consequently, individuals' interaction with their food and physical environment can significantly shape their health behaviours (Lake & Townshend, 2006), an observation central to the ecological models of health behaviour described in detail by Sallis, Owen, and Fisher (2008). The phenomenon of globalization in the form of increasing rate of both domestic and international migration in pursuit of education, a career or even tourism (Iredale, 2001) implies that individuals are constantly exposed to several new environments, and the tendency for their health behaviour to be influenced in such circumstances is prominent (Carballo & Nerukar, 2001). Dietary acculturation which has made less subtle the hitherto distinct food habits of individuals from different backgrounds is arguably the most discernible of the lifestyle habits attributed to migration (Holmboe-Ottesen & Wandel, 2012), while studies have shown that sleep quality (Villarroel & Artazcoz, 2016; Voss & Tuin, 2008), and physical activity (Afaible-Munsuz, Ponce, Rodriguez, & Perez-Stable, 2010) are equally impacted. Of greatest importance however is the fact that most often, unhealthy behaviours of the host country are adopted while traditional and healthier habits are simultaneously abandoned resulting in increased risk and incidence of chronic diseases such as diabetes mellitus and obesity (Mainous, Diaz, & Geesey, 2008; Misra &

Ganda, 2007). A critical examination of the probable modifications in health behaviours upon permanent or temporal relocation is thus a public health priority, necessary to inform health intervention.

2.1 Dietary patterns in relation health

According to Sobal, Bisogni, Devine, and Jastran (2006), the dietary pattern of a population is a critical index of their nutrition, which consequently determines overall health and well-being. The current global nutrition transition which has been strongly linked to the surge in obesity and its comorbidities highlights the profound role of nutrition in health and also in disease (Abrahams, McHiza, & Steyn, 2011; Popkin, 2006). The 'foetal origins' of adult diseases hypothesis suggests that the consequences of poor nutrition during pregnancy could have lifelong detrimental effects (Godfrey & Barker, 2000).

National and global healthy eating guidelines emphasise the consumption of foods predominantly rich in wholegrains, fruits, vegetables, poly- and monounsaturated fats, fish and also a reduction in processed foods high in saturated fats, sugar, salt and calories as well as excess alcohol consumption. The former is characteristic of the Mediterranean diet known to confer immense health benefits (Hu, 2003), whilst the latter depicts the 'Western diet' which conversely is associated with poor health and well-being (Cordain et al., 2005) as outlined by some selected studies shown in Table 1.

Table 1: Summary of studies demonstrating the effects of healthy eating

Author(s) (Year)	Design	Subjects	Main findings
Esposito et al. (2004)	Randomized, single-blind trial	180 patients with metabolic syndrome	Mediterranean diet intervention associated with reduced prevalence of metabolic syndrome and associated cardiovascular risk
Mokdad, Marks, Stroup, & Gerberding (2004)	Comprehensive MEDLINE search of English-language articles that identified epidemiological, clinical, and laboratory studies linking risk behaviours and mortality	United States population	Poor diet and physical inactivity accounted for 15.2% (365000) total deaths
Sofi, Cesari, Abbate, Gensini, & Casini (2008)	Meta-analysis of prospective cohort studies	Adults aged 20-90 years	Following the Mediterranean diet was associated with reduced mortality incidence (Relative Risk 0.91; 95% CI 0.89, 0.94), reduced CVD mortality (RR 0.91; 95% CI 0.87, 0.95) and reduced incidence of mortality from cancer (RR 0.94; 95% CI 0.92, 0.96), Parkinson's disease and Alzheimer's disease (RR 0.87; 95% CI 0.80, 0.96)
Trichopoulos & Lagiou (2004)	Routinely recorded adjusted overall mortality and food availability data in Mediterranean and non-Mediterranean EU countries	General population of 15 European Union countries	Gradual loss of survival advantage in the Mediterranean region owing to abandonment of Mediterranean dietary traditions
Buckland et al. (2011)	Prospective cohort study, with 13 years, 4 months' follow-up	40,622 Spanish adults aged 29-69 years	Adherence to an olive oil-rich Mediterranean diet was related to a significant reduction in all-cause mortality (HR= 0.79; 95 % CI 0.69, 0.91) and reduced risk of cardiovascular disease mortality (HR= 0.66; 95 % CI 0.49, 0.89)

An estimated 1.7 million (2.8%) deaths and 16 million (1.0%) disability-adjusted life-years (DALY's) worldwide are attributable to reduced consumption of fruits and vegetables (World Health Organization (WHO), 2011). The Lyon Diet Heart Study (de Lorgeril et al., 1999) was the first randomized controlled trial to show the cardioprotective and other health benefits of the Mediterranean diet. The health consequences associated with non-adherence to a Mediterranean diet have not been replicated in all regions, and the "French paradox", a large cohort study in which mortality from coronary heart disease was found to be low despite the high intake of saturated fat among the French (Renaud & de Lorgeril, 1992), demonstrates the extent to which research outcomes need to be interpreted with caution due to contextual variations, confounding variables, and methodological diversity (Mann, 2003). The French paradox was attributed in part to the high wine, hence flavonoid consumption among the French people (Renaud & de Lorgeril, 1992). Nevertheless, a healthy diet is key, and both the first and third leading risks for global mortality; high blood pressure and high blood glucose respectively are diet related (World Health Organization (WHO), 2009).

2.2 Physical activity in relation to health

The fourth leading cause of mortality worldwide is physical inactivity (Kohl et al., 2012). The evidence linking physical inactivity to morbidity and mortality were produced through the pioneering works of Morris and Crawford (1958), who produced compelling evidence that physical activity has a causal relationship with coronary heart disease; with intense physical activity associated with greater protection against coronary heart disease. A recent meta-analysis by Sattelmair et al., (2011), has corroborated the inextricable link between physical activity and coronary heart disease, while lack of physical activity has been strongly implicated in mechanisms

such as endothelial dysfunction which underlies the onset and progression of a host of debilitating diseases such as colon and breast cancer (Friedenreich & Orenstein, 2002), obesity (Fogelholm & Kukkonen-Harjula, 2000), and type 2 diabetes. Just as with dietary intervention, physical activity interventions have been used as adjuvants in the treatment of chronic diseases with considerable success recorded.

2.3 Sleep quality in relation to health

One of the most detailed descriptions of sleep quality was put forward by Buysse, Reynolds, Monk, Berman, and Kupfer (1989), who asserted that sleep quality includes quantitative aspects of sleep such as sleep duration, sleep latency, or number of arousals, as well as more purely subjective aspects, such as depth or restfulness of sleep. The health implications of poor sleep quality is profound as individuals who report sleep insufficiency are significantly more likely to experience poor general health, frequent mental and physical distress, activity limitations, depressive symptoms and pain (Strine & Chapman, 2005). A large national study in Taiwan found poor sleep quality to be a significant predictor of traffic and fall related injuries (Chen & Wu, 2010). Also, a growing body of evidence has accumulated on the negative consequences of sleep deprivation on weight, metabolism, and the endocrine system (Xi, He, Zhang, Xue, & Zhou, 2014) since the first prospective report in 2004 of an inverse association between short sleep and body mass index in a cohort of 496 young adults followed for 13 years (Hasler et al., 2004). In the current obesogenic environment, it is well demonstrated through observational studies with adults that inadequate sleep enhances our vulnerability to eat more, resulting in excess consumption of energy (Brondel, Romer, Nougues, Touyarou, & Davenne, 2010; St-Onge et al., 2011). On the other hand, neuroimaging experiments have also provided evidence that

insufficient sleep enhances hedonic stimulus processing in the brain underlying the drive to consume food (Benedict et al., 2012; St-Onge et al., 2012). This suggests that excess energy intake associated with not getting adequate sleep may be preferentially explained by hedonic stimulus, rather than changes in hormonal secretions (Chaput, 2014), specifically leptin and ghrelin hormones, as it is widely believed to be (Taheri, Lin, Austin, Young, & Mignot, 2004). Whichever way, continuity of this may result in sustained positive energy balance which is a proven mechanism in the onset and progression of obesity and its associated co-morbidities (Lobstein, Baur, & Uauy, 2004). The BMI influence of sleep deprivation could also underlie the increased plasma cholesterol, triglyceride, and blood pressure levels observed in poor sleepers (Bjorvatn et al., 2007), offering a plausible explanation to the increased cardiometabolic risk associated with poor sleep quality (Grandner, Jackson, Pak, & Gehrman, 2012; Lou et al., 2012). Since the majority of sleep-obesity researches have involved cross-sectional designs, causality has not been inferred, more so with emerging evidence that the sleep-obesity relationship may be bidirectional contrary to what is mostly reported in the literature (Nielsen et al., 2011) and paves the way for further sleep-health research (Cappuccio et al., 2008).

2.1 Effects of migration on health

The movement of individuals within and between countries usually necessitates modifications in certain aspects of lifestyle, the former often manifested in the rural-urban positive gradient in the prevalence of risky modifiable health behaviours (Ebrahim et al., 2010). The increasing rate of both domestic and international relocation, and the surge in lifestyle related morbidity and mortality, has therefore inevitably made migration a crucial social and global health determinant (Zimmerman, Kiss, & Hossain, 2011). Although migration could result in improved health, largely

due to improved medical care as well as improved hygiene hence less vulnerability to infectious diseases upon movement to developed countries, lifestyle associated diseases have been reported as a consequence of migration due to changes in health behaviours (Spallek, Zeeb, & Razum, 2011). Developed countries are usually the preferred final destinations and would have good health systems, but enroute migrants may face poor health conditions (Castles, Miller, & Ammendola, 2005). Even with regards to the better health due to improved medical care, there is evidence to suggest that immigration regulations and socioeconomic circumstances could impede access to and the use of health care (Jayaweera, 2011; Mladovsky, 2007). One criticism of the Marmot review on health inequalities in England for example is that it did not address comprehensively the effect of migration on health and for that matter the health of ethnic minorities or factors mediating these health effects (Salway et al., 2010). This provides a relatively reasonable basis for the examination of how acculturation defined as the process by which immigrants adopt the attitudes, values, customs, beliefs, and behaviours of a new culture (Abraído-Lanza, Armbrister, Flórez, & Aguirre, 2006) may negatively impact health, most importantly health behaviour. In fact, the majority of studies have shown that non-natives compared to natives are more vulnerable to suffer from chronic lifestyle-related diseases as observed in research investigating the incidence of CVD among Asians in the United Kingdom (Kuppuswamy & Gupta, 2005) and Canada (Rana, de Souza, Kandasamy, Lear, & Anand, 2014). Despite substantial evidence regarding ethnic pre-disposition however (Yusuf, Reddy, Ôunpuu, & Anand, 2001), it is worthy to note that environmental influences play an immense role in the expression of any genotypic traits; explained clearly by the gene-environment interaction (Tiret, 2002). As further evidence, CVD risk factors such as central obesity, glucose intolerance, as well

as elevated blood lipids which are marked among Asians (Chaturvedi, 2003) are influenced to a considerable degree by health behaviours such as increased atherogenic diets and sedentariness. Omega-3 and omega-6 polyunsaturated fatty acids influence gene expression, while omega-3 may confer additional protection against inflammation responsible for CVD, by weakening the effect of 5-lipoxygenase genotypes (Dwyer et al., 2004). Evidence of whether the higher prevalence of chronic diseases among migrants may be independently indicative of poor post-migration dietary and physical activity adaptation remains equivocal (Landman & Cruickshank, 2001), although migration has been proposed as a contributing factor to the excess risk of coronary heart disease among South Asians for example (Kuppuswamy & Gupta, 2005). Congruent with this hypothesis, a systematic review by Holmboe-Ottesen and Wandel (2012), showed a considerable increase in energy and fat intake, as well as decreased carbohydrate intake and a shift from pulses and wholegrain intake to more refined forms of carbohydrates, resulting in a decreased consumption of fibre among South Asians living in Europe. The review also showed an increased consumption of meat and dairy foods with decreased consumption of vegetables among some groups. The health effects are more pronounced upon migration from a low-income country to a high-income country, and a systematic review showed that high-income host countries significantly promote unhealthy weight gain among acculturated migrants (Delavari, Sonderlund, Swinburn, Mellor, & Renzaho, 2013). This observation may exacerbate with increasing duration of acculturation as shown in a large study involving immigrant subgroups in the United States (Goel, McCarthy, Phillips, & Wee, 2004). Madrigal et al., (2011) argued that the changes in BMI most probably reflects the changes in dietary habits and physical activity levels of migrants in their host region.

3.1.1 Effect of migration on diet

In his publication titled 'Food choice: beyond the chemical content', (Franchi, 2012), posited that taste, a major determinant of diet selection (Pollard, Kirk, & Cade, 2002) be examined as a cultural and relational object, as it involves beliefs, identity and perceptions. In spite of the resilience of dietary behaviour brought about by cultural influence, it is labile to change and dietary acculturation which involves changes in attitudes, beliefs, values and behaviours with regards to diet is no less a significant factor for changes observed in dietary practices (Neuhouser, Thompson, Coronado, & Solomon, 2004). The changes in diet borne by migration are more broadly mediated by both sociodemographic, such as host regions' food environment, access to traditional foods, and economic factors (Verbeke & López, 2005). Also whilst duration of living in a host region strongly influences the degree of dietary acculturation, food neophobia may be a significant barrier to dietary acculturation (Verbeke & López, 2005). A study by Lv and Cason, (2004) found an overall increased and decreased consumption of Western foods and traditional Chinese foods respectively among Chinese who had migrated to the United States, whilst a review of the literature by Gilbert and Khokhar (2008), suggests that dietary habits of some ethnic groups living in Europe are likely to become less healthy. The change in dietary behaviour has however been described by some researchers as generally bi-directional (Wahlqvist, 2002) as well as multidimensional, hence the dietary pattern upon migration could become healthier (Rosenmöller, Gasevic, Seidell, & Lear, 2011), or less healthy; the latter the most often reported (Himmelgreen, Romero Daza, Cooper, & Martinez, 2007; Renzaho & Burns, 2006; Saleh, Amanatidis, & Samman, 2002), even in cases whereby healthier traditional food behaviours have been maintained (Burns, 2004). The globalization of contemporary food markets means that dietary changes upon migration could be difficult to distinguish clearly, while the extent of

nutrition transition in the home region or country prior to migration may influence the process of dietary acculturation (Martínez, 2013). Also, past exposures in home country may influence dietary acculturation in the new environment (Méjean, Traissac, Eymard-Duvernay, Delpeuch, & Maire, 2009). For this reason, some reviews have failed to draw conclusive evidence about dietary acculturation and diet quality of immigrants (Satia-Abouta, Patterson, Neuhouser, & Elder, 2002), whereas other findings have been contradictory (Ayala, Baquero, & Klinger, 2008). To that effect, the use of multidimensional measures of acculturation has been called for in order to complement understanding of components of dietary acculturation (Abraído-Lanza et al., 2006).

3.1.2 Effect of migration on physical activity

Global physical activity levels are on the decline, and according to the World Health Organization (WHO) (2016), 23% of the world's adult population aged 18 years and above are insufficiently physically active, the statistic even more staggering among 11-17 year old adolescents with 81% of them insufficiently physically active. A comprehensive analysis of the global prevalence of physical inactivity by Dumith and colleagues in 2011 showed a positive association between Human Development Index (HDI) and physical inactivity ($\rho = .27$), with insufficient physical activity highest in the most developed countries as shown in figure 1.

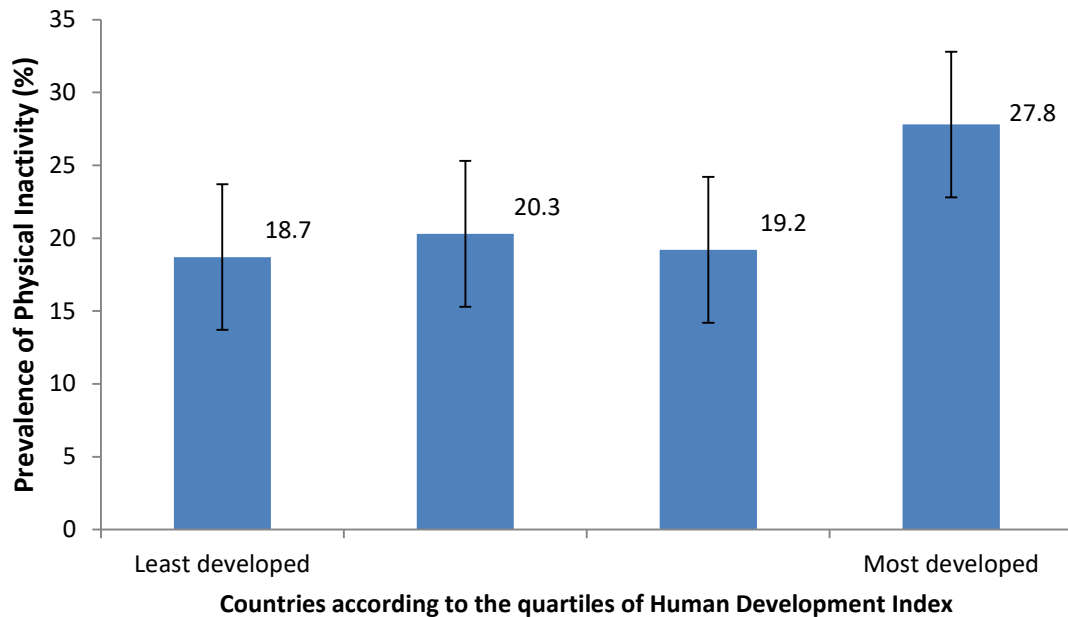


Figure 1: Global prevalence of physical inactivity according to quartiles of the Human Development Index

Adapted from Dumith et al. (2011).

Rural-urban migration has been cited on many occasions to be associated with decreased physical activity (Sullivan et al., 2011; Torun et al., 2002). More broadly, the levels of physical activity among individuals who make a transition from less to more developed countries have been reported to decrease considerably. In a study involving Brazilians living in Bournemouth, England, 78% of participants indicated that they had decreased their physical activity levels after moving to England (Bispo & dos Santos, 2013). Compared to Brazilians living at home (55%), physical inactivity prevalence was 79.3% among those living in England. Evidence suggests that modern and urban built environments, including transportation systems have the tendency to prioritize mechanized transport over active forms of transport such as walking and cycling, thus making such forms of transport less conducive (Litman, 2004), and this may explain the trend

observed in figure 1. A large study in Cameroon reported a significantly lower level of physical activity among urban dwellers compared to their rural counterparts ($P < .001$), with decreased cycling and walking time cited as part of the reasons for this observation (Sobngwi et al., 2002). The typical observation of decreased total physical activity may however be contrasted among those who take up casual, unskilled and labour intensive jobs after migration which consequently increases their occupational, non-leisure physical activity. The industrialization of developing countries, evolution of built rural environments to modern obesogenic ones, and the fact that migration is not only unidirectional, means that the most common theories of migration-related changes in physical activity does not explain other aspects of physical activity changes post-migration. These include specifically migration from one developed country to another, or between urban regions, indicating that other ostensible yet profound influences on physical activity such as climate and weather conditions (Belanger, Gray-Donald, O'Loughlin, Paradis, & Hanley, 2009; Matthews et al., 2001) could complement or more convincingly explain changes in physical activity observed after migration especially between countries, for instance the migration from a tropical (warm) to a temperate (cold) country and vice versa. The cold weather was cited as a hindrance to physical activity among American Indian/Alaska natives, African American, Filipino, Chinese, Latino, Korean, and Vietnamese migrant groups in the United States (Belza et al., 2004). A review of the literature by Caperchione, Kolt, and Mummery (2009) on physical activity among culturally and linguistically diverse groups recently migrated to Western societies identified physical inactivity to be a common challenge and outlined some of the inherent barriers to physical activity among this populations, shown in table 2.

Table 2: Barriers associated with physical inactivity among immigrant groups

Barriers	Explanation
Cultural and religious barriers	Religious practices such as fasting, sex appropriateness of physical activity, language acculturation, and religious fatalism
Social relationships	Lack of social support and high prevalence of isolation among culturally and linguistically diverse groups
Socioeconomic challenges	Factors such as low education and literacy levels, and deprivation
Environmental barriers	Safety concerns with regards to crime and violence within the neighbourhood, as well as change in climate
Perceptions of health and injury	Concerns of ill health and injuries related with physical activity

Adapted from (Caperchione et al., 2009)

Most of the literature reviewed by Caperchione et al., (2009), however involved older subjects, a group in which physical inactivity predominates due to medical reasons among other factors (Sun, Norman, & While, 2013). This therefore limits generalization, while the cross-sectional design of most of the studies restricts inference of causality (Mann, 2003).

3.1.3 Effect of migration on sleep habits

Among the multiplicity of changes in health behaviours that accompany migration is the alteration in the quantity and quality of sleep (Voss & Tuin, 2008), and the disruption in sleep patterns upon travelling across time zones (continents) is the most observable form of this phenomenon (Reilly & Edwards, 2007). The findings of studies exploring the disparities in sleep duration and sleep quality based on race/ethnicity have been mixed and to some extent tenuous (Anujoo et al., 2014; Cunningham, Wheaton, Ford, & Croft, 2016; Jackson et al., 2014), and very few studies have investigated whether the reported disparities may be due to acculturation (Hale & Rivero-Fuentes, 2011). This may be explained by the fact that various symptoms of poor sleep quality such as sleep latency, non-restorative sleep, snoring, snorting/gasping and daytime

sleepiness are associated with multiple sociodemographic as well as economic factors (Grandner et al., 2013). The psychological and psychosomatic symptoms that accompany acculturation have however been suggested to explain the sleep disturbances typically reported by migrants (Sundquist, Bayard-Burfield, Johansson, & Johansson, 2000). On the contrary, Mexican-born US immigrants were reported to have better sleep quality compared to the general US population (Seicean, Neuhauser, Strohl, & Redline, 2011). Jean-Louis et al., (2001), argues that differences in sleep complaints may not be explained solely on the basis of immigration status in spite of the significant influence of ethnicity of sleep disturbance, providing a reasonable explanation to the discrepant findings in this area of research. The environmental influence on sleep components, through the regulation of the physiological sleep-wakefulness circadian rhythms has however been unequivocal. Given that studies have persuasively demonstrated that the quality or duration of sleep may be markedly impacted by variables such as noise (Halperin, 2014), light and temperature (Groeger, Zijlstra, & Dijk, 2004) of the sleep environment, and that relocation may result in changes in such variables enhances understanding of the migratory influence on sleep patterns despite the lack conclusive evidence. Large cities, which often receive large number of migrants are mainly characterized by increased noise which consequently affect sleep quality (Muzet, 2007).

4.1 Health behaviours of university students living away from home

The period through university, is a crucial stage where health-compromising behaviours such as poor dietary habits, physical inactivity and poor sleep habits can be adopted or influenced (Dodd, Al-Nakeeb, Nevill, & Forshaw, 2010; El Ansari, Stock, & Mikolajczyk, 2012; Lemma, Gelaye, Berhane, Worku, & Williams, 2012), particularly among students studying away from home

(Abolfotouh, Bassiouni, Mounir, & Fayyad, 2007). The challenges faced by students studying outside their home countries (referred broadly to as international) students are not dissimilar to those faced by other migrant groups (Tidwell & Hanassab, 2007), and acculturation has been shown to lead to changes in health behaviours within this population (Yan & Fitzpatrick, 2016). For most students living outside their home countries, the separation from family and familiar surroundings to independent living is accompanied by the exposure to new environments which significantly mediate the observed changes in health behaviours. Although both positive and negative behaviour changes have been reported among those students studying away from home (Beasley, Hackett, & Maxwell, 2004), unhealthy behaviour changes has been consistent considering the extant literature. The commonly reported weight gain among university students have been most often associated with poor eating practices and sedentary lifestyle of university students, especially those living away from home (Racette, Deusinger, Strube, Highstein, & Deusinger, 2008).

4.1.1 Dietary habits of students living away from home

Based on the social cognitive theory and ecological models of human health behaviour, Story, Neumark-Sztainer, and French (2002) conceptualized the influences on adolescents eating behaviours and food choices into four levels outlined in table 3.

Table 3: Factors influencing adolescents' eating behaviours

Level	Components
Individual or intrapersonal influences	Biological factors (hunger) and psychosocial factors (beliefs, knowledge, self-efficacy, taste
Social environmental or interpersonal	Peers, friends and family influence
Physical environmental or community setting	Schools, fast food outlets, convenience stores, shopping malls, vending machines
Macrosystem or societal	Mass media, marketing and advertising, social and cultural norms

Although posited initially to explain the influences on adolescent eating and dietary behaviours, the above model widely relates also to the food habits of young adults and to some extent adults; most university students fit this description. With regards to individuals studying outside their home countries, it is possible that significant changes would be observed in all these factors, except individual influences and this may result in alterations in already established dietary habits, and empirical evidence exists to support this hypothesis (Reeves & Henry, 2000). While it is widely believed that an increased responsibility for food choices and practices accompany the transition to university (Šatalić, Colić Barić, & Keser, 2007), the dimensions might be broader among international students. A study carried out by Papadaki and colleagues in 2007 reported that while Greeks studying in the United Kingdom decreased their consumption of whole-fat yoghurt, margarine and feta cheese, the consumption of fresh fruits, raw vegetables, oily fish and seafood also decreased, with concomitant increase in sugar and alcohol consumption. Overall, dietary habits of those students living away from Greece was less healthy compared to those living at home, despite some of the observed positive changes. Because the dietary pattern in Greece is predominantly 'Mediterranean' (Simopoulos, 2001), it is possible that this may have magnified the difference in dietary habits between students back home in Greece and Greek

students living in the United Kingdom, where the food environment can accurately be described as 'Western' (O'Flaherty, Flores-Mateo, Nnoaham, Lloyd-Williams, & Capewell, 2012). The findings by Papadaki et al., (2007) have nonetheless been replicated in similar studies involving Greek students in the UK (Kremmyda, Papadaki, Hondros, Kapsokefalou, & Scott, 2008) as well as Asian university students in the United States (Pan, Dixon, Himburg, & Huffman, 1999), in which increased consumption of snacks high in salt, sugar and fat was observed among international students.

Qualitative research examining the factors underlying dietary patterns among university students reported individual factors, social networks, physical environment and macro environment as factors mediating their food choices (Deliens, Clarys, De Bourdeaudhuij, & Deforche, 2014), indicating that the shifts in physical and social environment, as well as the changes in overarching societal structures may explain the observed modifications in dietary behaviours of international students.

4.1.2 Physical activity levels of students living away from home

A review by Irwin (2004) of the prevalence of physical activity among university students worldwide showed that more than half of university students are insufficiently physically active to acquire the associated health benefits, with students living on campus less active compared to those living away from campus. Haase, Steptoe, Sallis and Wardle (2004) also reported that leisure time physical activity is below recommended levels among a considerable number of students in a study that involved over 19000 students from 23 countries. Although the physical activity levels among university students is generally poor, there is a belief that physical activity would be even lower among those students studying outside their home country. Female

international university students in Germany have been shown to be significantly less physically active in comparison to native female students (OR = 0.11, 95% CI 0.01-0.92) (Kramer, Prufer-Kramer, Stock, & Tshiananga, 2004). The study however found no difference between male international and German male students in terms of engagement in exercise (Kramer et al., 2004), highlighting the gender disparity underlying participation in physical activity (Troost et al., 2002). In another study involving international students in the United States, students from African and Asian countries were reported to spend a significantly less amount of time doing physical activity in comparison to student from other regions (Yoh, Yang, & Gordon, 2008). These studies were however silent on the physical activity of students back in their home countries, and since past behavior may significantly influence current and future engagement in physical activity (Hagger, Chatzisarantis, & Biddle, 2001), the finding of these studies hold only modest implications for health promotion. Regardless of the individual specific psychological mediators of physical activity as explained by the theory of planned behavior and the theory of reasoned action (Hagger, Chatzisarantis, & Biddle, 2002), physical environmental factors have shown consistent and significant relations with engagement in physical activity (Giles-Corti & Donovan, 2002). This may explain the observed differences in physical activity upon relocation to new physical environments in the context of studying abroad. For instance, accessibility to exercise facilities such as gyms was reported as a main facilitator for engagement in regular exercise among international students in the United States (Yan & Fitzpatrick, 2016).

4.1.3 Sleep quality among university students

Consolidation of newly acquired information in memory is significantly optimized by good quality sleep (Diekelmann & Born, 2010), an indication that good quality sleep may seem particularly

relevant among university students, considering their academic obligations. In reality however, this is not the case as university students have been shown to be characteristically poor sleepers (Curcio, Ferrara, & De Gennaro, 2006; Lund, Reider, Whiting, & Prichard, 2010). Among the 17,465 university students from 24 different countries assessed for sleep duration, 21% were found to be short sleepers (6%, <6 hours; 15%, 6-7 hours) (Steptoe, Peacey, & Wardle, 2006); indicating that inadequate sleep duration may be of particular concern among university students. Aside increasing academic demands (Lemma et al., 2012), a substantial number of studies have indicated that the increased use of stimulants, notably caffeine by students may account for shorter sleep durations, poor self-reported sleep quality and increased daytime sleepiness (Clegg-Kraynok, McBean, & Montgomery-Downs, 2011; Lohsoonthorn et al., 2013; Sanchez et al., 2013). Other factors reported to contribute towards poor sleep quality among students include environmental noise (Brown, Buboltz, & Soper, 2002), irregular bedtime schedules (Kang & Chen, 2009), as well as poor sleep hygiene practices (Suen, Hon, & Tam, 2008).

5. Conclusion and recommendation

The extant literature highlights possible significant alterations in diet, physical activity levels and sleep quality upon migration, as well as poor sleep quality among university students in general. The literature is however bereft of evidence about the health behavior changes and sleep quality among the increasing and ethnically diverse groups of international students, while the clustering of risky health behaviours has not been adequately researched among this population. Investigating this would thus hold significant implications for health promotion efforts among international students.

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**Impact of living away from home country on the health behaviours of international students
at the University of Chester, UK. A cross-sectional study**

Word count: 4374

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Rationale for journal choice

The journal appropriate for the submission of this study is BioMed Central (BMC) Public Health; an open-access, peer-reviewed journal that considers articles on disease epidemiology, and the understanding of all other aspects of public health. The study's aim of investigating the influence of international relocation on the lifestyle aspects of international students is in keeping with the journal's special focus on the social determinants of health, since both domestic and international migration are significant social health determinants.

RESEARCH ARTICLE

Abstract

Background: A fairly substantial body of evidence indicates that modifiable health behaviours may vary contingent upon a students' residency, including whether students are studying away from their home country. This study aimed to investigate the impact of living away from home country on some lifestyles of international students at the University of Chester, UK.

Method: Twenty-two international postgraduate students (23-41 years) at the University of Chester completed validated questionnaires relating to self-reported dietary patterns, physical activity and sleep quality based on circumstances before and after arrival in the UK. Self-reported body mass index (BMI) and self-reported waist circumference were also recorded.

Results: Arrival in the UK was associated with a decreased adherence to the Mediterranean diet ($p = .857$), manifested in decreased fish, fruits and vegetables consumption. Decreased participation in sports ($p = .007$), as well as decreased sleep duration ($p = .179$) was reported upon arrival in the UK. Poor sleep quality was found to be prevalent within this sample (54.5%). The study observed both positive and negative lifestyle changes overall, although the latter was predominant.

Conclusion: This sample of international students made more unfavourable changes in their dietary intake, physical activity levels and sleep duration upon relocating to the UK. It is imperative that close attention is paid to how international students adjust to life within the UK in order to provide healthier climate for learning.

1. Introduction

The literature is replete with evidence demonstrating unhealthy lifestyles upon transition to university (Deforche, Van Dyck, Deliens, & De Bourdeaudhuij, 2015; Laska, Pasch, Lust, Story, & Ehlinger, 2009), with the situation of equal concern among students from overseas (Yan & Fitzpatrick, 2016) who have to adjust to circumstances in host countries (Constantine, Anderson, Berkel, Caldwell, & Utsey, 2005). Studies have attributed the significant weight gain upon commencement of university to a coupling effect of decreased physical activity (PA) and poor dietary practices among university students (Racette et al., 2008). The health concerns are not limited to excessive weight gain, but also increased risk for other chronic diseases such as cardiovascular disease (CVD), hypertension, and diabetes (Ibrahim et al., 2014). Short sleep duration, a risk factor for cardiometabolic disease is also prevalent among university students, while overall sleep quality is equally poor among students which could result in a worsening of neurocognitive and academic performance (Curcio et al., 2006).

Universities in the UK have recently seen a high enrolment by international students; students living and studying outside their home country (United Nations Educational Scientific and Cultural Organization (UNESCO), 2016). Aside the unique challenges faced by international students such as having to adjust to new systems of learning (Tidwell & Hanassab, 2007), they also undergo the process of acculturation comparable to other migrant groups, which may pose significant challenges to their health. Recent observational studies on the influences of migration on health behaviours of international students have uncovered intriguing findings, which nonetheless has opened up possibilities for new research. Prior work has not considered changes in health behaviours among an ethnically diverse group of international students, especially in the UK.

Also, the majority of studies involved students from only one country, with only single health behaviour changes assessed (Pan, Dixon, Himburg, & Huffman, 1999; Papadaki & Scott, 2002). Likewise, sleep quality has not been assessed among this population. This present study thus contributes towards addressing the inadequacy of the literature on students' health behaviour changes, specifically dietary patterns, PA level and sleep duration, and presents valuable implications for health promotion among international students.

Aim:

To investigate the changes in lifestyle habits of international students upon commencement of their studies at the University of Chester, UK.

Objectives:

To determine whether;

- i. international students change their dietary patterns upon moving to the UK.
- ii. the PA levels of international students has changed since they moved to the UK.
- iii. the sleep duration of international students has been altered upon commencement of studies in the UK, and to assess their sleep quality.
- iv. associations exist between sleep quality, PA level and dietary patterns among international students, and to assess the relationship between these variables and adiposity indices.

The study tested the following hypotheses:

- i. There is no significant difference in the dietary patterns of international students before and after arrival in the UK.

- ii. The PA level of international students does not change upon commencement of their studies in the UK.
- iii. There is no significant difference in sleep duration of international students before and after arrival in the UK.

2. Methods

Participants: Twenty-two postgraduate students (5 males, 17 females) at the University of Chester, aged between 23 and 41 years participated in this study. The Faculty of Medicine, Dentistry and Clinical Sciences Research Ethics Committee approved this study (Appendix).

Inclusion and exclusion criteria: International students who had never lived in the UK prior to the commencement of their studies, and were living on their own in the UK were recruited for this study. Students who were dieting or following specific PA advice were not included in the study.

Research design:

This was a cross-sectional exploratory investigation based on a quantitative approach.

Data collection:

Participants completed the Baecke habitual physical activity questionnaire, the 14-item Mediterranean Diet Adherence Screener (MEDAS-14), and the Pittsburgh Sleep Quality Index (PSQI) in order to evaluate respectively, their PA, adherence to Mediterranean diet, and sleep quantity/quality. The questionnaires were completed twice; the first based on circumstances before participants arrived in the UK, and second, to reflect circumstances while back in their home countries. Participants also completed once the Mediterranean diet score tool (MedDietScore: 0-55). BMI was computed from self-reported weight (Kg) and height (m), as

weight divided by the square of the height. Self-reported waist circumference, as well as drinking and smoking status were also assessed. Students were invited to participate in the study through the University of Chester International students' Facebook group and also face-to-face invitations. Questionnaires were distributed to students who consented to take part in the study via email, and completed questionnaires were also returned via email, with a participants' response rate of 55%. Demographic information recorded include; age, sex, and nationality. The programme and level of study were also recorded for each participant.

Data analysis:

All data collected was analysed using the software Statistical Package for Social Sciences (Version 22) (SPSS) (IBM Corp., 2013). All analysis was conducted at a significance level of .05 or at a 5% probability of incorrectly rejecting the null hypothesis. All data variables were checked for normality using the Shapiro-Wilk test, and also examined whether they met parametric assumptions as part of the analysis. Depending on whether the variables met or violated parametric assumptions, paired t-test or Wilcoxon test was used to assess differences between variables before and after relocation to the UK, while the Pearson's correlation and Spearman's rho correlation was used to test association between variables. Multiple linear regression analysis was conducted to predict BMI from lifestyle variables. Descriptive statistics was conducted on demographic data collected. Means are reported as 'mean \pm standard deviation (SD)' unless otherwise stated.

3. Results

Participants were drawn from 11 nationalities; Afghanistan, Burundi, Egypt, Ghana, India, Lebanon, Malaysia, Nigeria, Palestine, Uganda, and Vietnam. Mean age of the sample was 29.1 ± 4.9 years. None of the participants were current smokers, and only 18.2% drink alcohol.

Dietary Issues

Mediterranean diet adherence

The mean (\pm SD) MEDAS-14 score of students before arrival in the UK showed a slight and non-significant decrease from 6.0 ± 1.6 to 5.9 ± 1.9 upon migration to the UK as shown in Table 5.

Table 1: Changes in Mediterranean diet score of participants upon arrival in the UK

	Mean	25 th percentile	50 th percentile	75 th percentile	p- value
14-item Mediterranean diet score before arrival (SD)	6.0 ± 1.6	5.0	6.0	7.0	.857
14-item Mediterranean diet score after arrival (SD)	5.9 ± 1.9	5.0	5.5	6.0	

While the MEDAS-14 score of six participants increased upon migration to the UK, that of five other participants decreased. No change in Mediterranean diet adherence was observed among nine of the participants upon moving to the UK.

The average amount of vegetable consumed per day by participants decreased by 59.1g, from 263.6g (home country) (median=200g) to 204.5g (UK) (median=150g), although this was not statistically significant ($p = .054$). Increased daily vegetable consumption was observed in two participants upon moving to the UK, while there was no change and also a decrease vegetable consumption among ten students in each case. Similarly, no significant difference ($p = .323$) was

observed in the amount of fruit units consumed by participants per day. Nevertheless, average amount of fruit units consumed per day decreased from 2.7 (median=2.0) to 2.1 (median=2.0) units; equivalent to 216g and 168g respectively upon arrival in the UK. The changes in mean amounts of meat, butter, carbonated drinks, fish, as well as commercial sweets and pastries consumed before and upon arrival in the UK are summarized in table 6. None of the changes was statistically significant.

Table 2: Mean amounts/times of some selected foods consumed back home and in the UK

Food item	Home country	UK
Meat (g/day)	110.8	62.5
Butter (g/day)	6.0	7.6
Sweet/ Carbonated drinks (times/day)	0.65	0.55
Fish (g/week)	244.3	196.0
Commercial sweets and pastries (e.g. cakes, cookies, biscuits, or custard) (times/week)	2.7	3.1

Nearly all students in this study (90.9%) preferentially consumed chicken, turkey, or rabbit meat instead of veal, pork, hamburger or sausage back home, and this did not change upon moving to the UK. Whilst 40.9% of students reported using olive oil as culinary fat back home, this figure increased to 50% upon arrival in the UK.

Mediterranean diet score (MedDietScore: 0-55) tool

The MedDietScore tool ranges on a scale of 0 to 55, a higher value represents a greater adherence to the Mediterranean diet (Panagiotakos, Pitsavos, Arvaniti, & Stefanadis, 2007). The tool has a positive and negative predictor value of 33% (95% CI; 30-35%) and 97% (95% CI; 96-98%)

respectively regarding obesity, with an optimal cut-off point of 26.8; the value that better distinguishes individuals with the disorder from controls (Panagiotakos et al., 2007). The mean diet score of males was 23.3 ± 2.5 , whereas that of females was 26.6 ± 5.9 , indicating a greater adherence to Mediterranean diet among males than females and most importantly suggests a lower probability of obesity prevalence among male participants compared to females. Contrary to this, mean self-reported BMI was higher in males than females. Mean score of the total sample was 25.9 ± 5.5 . Unadjusted MedDietScores ranged from 20 to a high of 39.

Physical activity

Table 3 contains a summary of the levels of physical activity reported among the participants.

Table 3: Paired t-test of levels of leisure and sport indices before and after arrival in the UK

	Home country	UK	p-value
Sport index	2.54 ± 1.10	1.90 ± 0.71	.007*
Leisure index	3.15 ± 0.50	3.32 ± 0.58	.358
Total physical activity index ^β	5.69 ± 1.15	5.19 ± 0.93	.100

* denotes statistical significance

^β the work index was not considered in computing the total physical activity index since participants were all students and were expected to have similar work indices, and also to avoid bias due to work index back home which may be expectedly greater than current work index.

The mean sport index value of participants was shown to have decreased significantly ($p = .007$) to 1.90 ± 0.71 upon arrival in the UK, in comparison to when they were back home 2.54 ± 1.10 . The opposite was however recorded for the mean leisure index, with arrival in the UK associated with a corresponding increase in leisure index from 3.15 ± 0.50 to 3.32 ± 0.58 , although this change was not statistically significant.

Table 4: Comparison of level of participation in a sport and active transport before and after arrival in the UK

	Home country	UK
Number of participants who played a sport	14 (63.6%)	6 (27.3)
Minutes of active transport	30-45 minutes	15-30 minutes

Among the participants, only 27.3% reported playing a sport upon arrival in the UK, compared to the 63.6% positive responses recorded when this question was based on the circumstances before students arrived in the UK for their studies, indicating a notable shift. Conversely, active transport was shown to have increased; manifested in the lower average number of minutes walked or cycled per day to and from work while back home, in comparison to when participants arrived in the UK. This particular observation must have contributed to the greater total PA index upon arrival in the UK.

Sleep quality

The sleep components of the 22 participants are summarized in Table 1.

Table 5: Summary of sleep components among international students

	No difficulty (%)	Slight difficulty (%)	Moderate difficulty (%)	Severe difficulty (%)
Subjective sleep quality	22.7	68.2	9.1	
Sleep latency	27.3	59.1	4.5	9.1
Sleep duration	45.5	36.4	9.1	9.1
Habitual sleep efficiency	63.6	9.1	4.5	22.7
Sleep disturbances	13.6	81.8	4.5	0
Use of sleep medication	72.7	18.2	4.5	4.5
Daytime dysfunction	13.6	68.2	13.6	4.5

The average number of hours of sleep in this sample was found to meet sleep recommendations for young adults (Hirshkowitz et al., 2015), with mean sleep duration recorded to be 7.47 ± 1.97 Hr. However, 40.9% representing nine participants reported sleep duration less than 7 hours, ranging between 5 to 6.3 hours. Also, 31.8% of students reported longer sleep hours (>8 hours). Compared to males 6.29 ± 1.21 Hr, females were shown to have longer sleep durations 7.82 ± 2.04 Hr.

Moving to the UK was not associated with a statistically significant change in sleep duration within this sample ($p = .179$), although there was marginal decrease in average sleep duration from 8 ± 1.26 Hr to 7.47 ± 1.97 Hr. Regarding subjective sleep quality, 68.2% reported fairly good sleep quality, while 9.1% indicated that their sleep quality was fairly bad. Of particular relevance

within this sample was also the fact that 59.1%, 81.8%, and 68.2% experienced slight difficulties in terms of sleep latency, sleep disturbances, and daytime dysfunction respectively. Very poor habitual sleep efficiency was reported by only 22.7% of the sample, with the majority of students (63.6%) reporting 'very good' habitual sleep efficiency. This may have been accounted for by the short median sleep latency of 16 minutes observed within this sample.

The global Pittsburgh Sleep Quality Index (PSQI) score among this sample ranged from 2 to 10, both minimum and maximum range recorded 9.1% of participants. Students with PSQI scores greater than the clinical cut-off 5 were categorized as poor sleepers (Carney, Edinger, Meyer, Lindman, & Istre, 2006; Grandner, Kripke, Yoon, & Youngstedt, 2006). As such, more than half (54.5%) of international students within this sample were found to be poor sleepers. The extent to which some factors influence the sleep quality among this sample are highlighted in the table 6.

Table 6: Factors influencing sleep quality of students

	Not during the past month (%)	Less than once a week (%)	Once or twice a week (%)	Three or more times a week (%)
Cannot get to sleep within 30 minutes	12 (54.5)	4 (18.2)	5 (22.7)	1 (4.5)
Wake up in the middle of the night or early in the morning	9 (40.9)	5 (22.7)	4 (18.2)	4 (18.2)
Have to get up to use the bathroom	5 (22.7)	6 (27.3)	7 (31.8)	4 (18.2)
Cannot breathe comfortably	20 (90.9)	1 (4.5)	1 (4.5)	-
Cough or snore loudly	18 (81.8)	3 (13.6)	-	1 (4.5)
Feel too cold	17 (77.3)	5 (22.7)	-	-
Feel too hot	12 (54.5)	6 (27.3)	4 (18.2)	-
Had bad dreams	16 (72.7)	5 (22.7)	1 (4.5)	-
Have pain	17 (77.3)	3 (13.6)	2 (9.1)	-

Waking up in the middle of the night or early in the morning, as well as having to get up to use the bathroom appears to be the most often reported sleep trouble among participants. Other reasons cited as hindering quality sleep among students were; worries about studies and other matters. Students also usually went to bed late, with all but one of the students going to bed after or at 10pm 21(95.5%), with some students going to bed as late as midnight and beyond 13(59.1%).

Body composition indices

Table 7: Mean BMI and waist circumference by gender

	Males	Females
Body Mass Index (Kg/m ²)	25.5 \pm 0.2	21.1 \pm 3.0
Waist circumference (cm)	55.0 \pm 24.1	59.5 \pm 21.2

Male participants had higher self-reported mean BMI (25.5 \pm 0.2 Kg/m²) than females (21.1 \pm 3.0 Kg/m²), indicating an overweight average BMI for males and a normal BMI for female participants. The mean waist circumference for both males (55.0 \pm 24.1 cm) and females (59.5 \pm 21.2 cm) were below the waist circumference cut-off points for which increased disease risk has been implicated, that is, >102cm and > 88cm for males and females respectively (World Organization Health (WHO), 2008). The rate of overweight within this sample was 27.8%, with none of the participants found to be obese.

This study found a very low inverse relationship between BMI and PA index. The correlation coefficient was however stronger for BMI and Mediterranean diet adherence, with a modest inverse correlation observed between Mediterranean diet adherence and BMI. Waist circumference showed a very low positive association with Mediterranean diet adherence, contrary to expectations of an inverse relationship, and a very low negative association with PA index. None of the associations achieved statistical significance, although the association between BMI and adherence to Mediterranean diet approached statistical significance as shown in table 8.

Table 8: Bivariate correlation between body composition indices and lifestyle factors

Body composition Index	Mediterranean diet adherence score		Physical activity index	
	r_s	p	r	p
BMI	-.464	.070	- .153	.545
Waist circumference	.108	.703	-.115	.659

r_s – Spearman rank correlation; r- Pearson correlation

Bivariate relationship between physical activity, sleep quality and dietary pattern

The bivariate investigations were based on current observations, that is after arrival in the UK. Spearman's rank-order correlation showed a very low-positive correlation ($r_s = .105$) between PA index and Mediterranean diet adherence ($p = .658$). In contrast, a low negative correlation ($r_s = -.031$) was observed between PA and overall sleep quality ($p = .890$), while a modest negative ($r_s = -.427$) correlation existed between overall sleep quality and Mediterranean diet adherence ($p = .060$).

A very low positive Pearson's correlation coefficient ($r = .050$) was obtained between sleep duration and PA index ($p = .823$) within this sample. There was a modest, positive correlation ($r = .581$) between subjective sleep quality and global sleep quality index, which was statistically significant ($p = .005$).

Multiple regression analysis

A multiple regression analysis was conducted to predict BMI from physical activity, dietary pattern and sleep duration. However, BMI was not statistically significantly predicted by these variables, $F(3, 12) = 2.081$, $p = .156$, $R^2 = .342$. For each point increase in MEDAS-14 score and PA index, there is a decrease of BMI by 0.605 Kg/m^2 ($p = .150$) and 0.919 Kg/m^2 ($p = .382$) respectively, holding all other variables constant for each case. Added to this, an hour increase in sleep

duration was associated with an increase in BMI by 1.25 Kg/m² (p= .191), holding all other variables constant.

4. Discussion

In this multi-ethnic sample from the international student population at the University of Chester, it was noted that certain aspects of modifiable health behaviours were altered among students who travelled from different countries to study in the UK, corroborating what has been reported in the literature. None of the students were current smokers, a very positive observation since tobacco smoking is the third leading cause of mortality globally (World Health Organization (WHO), 2009).

Understanding aspects of dietary changes among international students in the UK is necessary for the provision of a positive learning climate for this group of students (Edwards, Hartwell, & Brown, 2010). While there was no change in the MEDAS-14 score of some students, that of other students either increased or decreased. The varying directions of change in MEDAS-14 scores observed is in keeping with suggestions that changes in dietary patterns upon migration is not necessarily linear (Satia-Abouta et al., 2002). The protective health benefits the Mediterranean diet has been consistently reported (Sofi, Abbate, Gensini, & Casini, 2010). Whilst the departure from an ideal Mediterranean diet was slightly more pronounced upon arrival in the UK, other specific dietary changes were recorded. Although some positive changes were apparent, such as decreased meat and sweet/carbonated drinks consumption, mean consumption of fish and butter were found to have decreased and increased respectively. In addition to this, students were currently (estimated 372.5g/day) not meeting the minimum 400g per day fruits and vegetables recommendations proposed by the (World Organization Health (WHO), 2015) for

healthy living, despite the fact that this recommendation was met back home (estimated 479.6g/day).

Fruit and vegetable consumption among university students is however generally very poor (Peltzer & Pengpid, 2014). Even though a host of psychosocial and socioeconomic factors mediate fruits and vegetables intake among students (Hartman, Wadsworth, Penny, van Assema, & Page, 2013), the obvious lack of familiarity with indigenous fruits and vegetables may be a particularly important barrier within this sample. This thus concurs with suggestions by Edwards et al., (2010) that food neophobia significantly influences international students' dietary behaviours. The lack of accessibility, availability and the presumably high costs of imported ones they may be familiar might also explain the decreased fruit/vegetable consumption. Recent statistics in the UK indicate that although prices of all food groups fell between 2014 and 2015, the prices of fruits rose by 1.4% (Department for Environment Food and Rural Affairs (Defra), 2014), highlighting the potential influence of costs on fruit consumption. In one study, home availability ($r = .33$) of fruits/vegetables showed the strongest correlation of fruits/vegetables intake among a population of over 3000 students in the US (Neumark-Sztainer, Wall, Perry, & Story, 2003).

Unlike meat and poultry, fish is perceived to be more expensive within the UK (Leek, Maddock, & Foxall, 2000), and international students may be forced to substitute fish with the relatively cheaper options of meat and poultry in order cut down expenses. Students in this sample may thus be deprived of the health benefits of omega-3-fatty acids of which fish is a major source (Verbeke, Sioen, Pieniak, Van Camp, & De Henauw, 2005). Despite the fact that fat spreads saw an increase in consumption upon arrival in the UK, it is noteworthy that this may not be negative since 'reduced fat' spreads have become increasingly popular within the UK (Public Health

England (PHE) and the Food Standards Agency (FSA), 2014). Nevertheless, the significant fall in butter and fat spread prices (Department for Environment Food and Rural Affairs (Defra), 2014) must have made it more attractive to this group of students. Meat consumption decreased substantially among students upon arrival in the UK, contrary to what is usually observed upon migration to Western countries (Holmboe-Ottesen & Wandel, 2012). A study by Pan et al., (1999) showed that meat consumption decreased significantly among Asian students after migrating to the United States, while a similar observation was reported among Greek students in the UK (Papadaki & Scott, 2002). Since meat is usually incorporated in most dishes, a lack of culinary skills or time to cook may likely explain this observation. In the study by Papadaki and Scott (2002), majority of the students (54%) indicated that the quality of the meat in the UK was inferior to what they consumed back home. Another major cause for concern among this sample of students was the increased consumption of commercial sweets and pastries upon arrival in the UK. Commercial sweets are very high in free sugars, which have been implicated in the obesity epidemic (World Health Organization (WHO), 2015). Increased CVD risk is also strongly related to high trans-fat consumption of which commercially produced pastries are major sources (Dariush Mozaffarian, Katan, Ascherio, Stampfer, & Willett, 2006). The increased consumption of sweets and pastries potentially reflects unhealthy snacking habits among this sample of students, and this could displace other important sources of micronutrients from their diets (Ovaskainen et al., 2006). Overall, the assumption of primary responsibility for food shopping and food preparation, financial and time constraints could have influenced some of the observed unhealthy changes within this sample upon leaving their home country (Kremmyda et al., 2008; Papadaki & Scott, 2002).

The various indices of adiposity can be significantly influenced by the quality of an individual's dietary pattern, with greater adherence to the Mediterranean diet associated with a decrease in adiposity indices (Lassale et al., 2012; Mozaffarian, Hao, Rimm, Willett, & Hu, 2011). This study found an inverse association between adherence to the Mediterranean diet and general adiposity assessed by BMI, although that of abdominal adiposity, assessed by waist circumference was not replicated. This implies that students who experienced a considerable decrease in their MEDAS-14 score are at a greater risk of becoming obese or developing other diet related chronic diseases. Finally, regarding the dietary pattern of students, the MEDAS-14 score was affected by the fact that majority (81.8%) of the students do not consume alcohol, and for that matter wine which forms an essential component of the Mediterranean diet. This can be viewed in a positive sense regardless, since most university students have been reported to abuse alcohol, a risk factor for numerous health conditions (Perkins, 2002).

The decline in sports participation upon arrival in the UK is of great public health concern. Sport contributes immensely towards total PA which prevents the development of CVD and other chronic diseases such as type 2 diabetes, obesity and some forms of cancer such as colon and breast cancer (Thompson et al., 2003). Considering the various sports groups within the University of Chester, a participation in sporting activities would have been expected among participants. Undergraduate international students are more likely to get adequately established with sports clubs in a foreign university compared to their postgraduate counterparts, since in most cases the duration of undergraduate studies (three years) is longer than a one-year master's study for example (Li & Stodolska, 2006), unless in the case of PhD students. In addition, most of these sports groups are run on competitive basis rather than for recreation, and this could deter

students' participation (Heo & Lee, 2007). The situation concerning PA was not all gloomy however since students engaged in active transport (cycling and walking) for longer each day than they did back home. Site seeing is a putative reason for choosing a foreign study destination (Nyaupane, Paris, & Teye, 2011), hence students may like to see around and what better way to do so than walking. Students rather than footing bus or taxi fares, may decide to walk to and from places within reasonable distances as a means of saving on their limited budgets.

A transition from home country to the UK was associated with a marginal decrease in the number of hours of sleep, the first time this observation has been reported among an overseas student sample. The self-reported sleep deprivation observed within this sample is congruent with what has been reported in the literature (Lund et al., 2010), and this may be due to a host of factors. Of greater importance however is the adverse physiological changes central to CVD risk that may underlie sleep deprivation among this sample (Odegaard, Koh, Gross, Yuan, & Pereira, 2011). This is compounded by the fact that the mean Global PSQI score of 5.86 ± 2.44 obtained within this sample is slightly greater than the clinical cut-off point of 5 (higher scores indicate poorer sleep quality), thus suggesting overall poor sleep quality within this sample. Both sleep quality and quantity are closely related to learning capacity and academic performance (Curcio et al., 2006; Dewald, Meijer, Oort, Kerkhof, & Bögels, 2010); the primary purpose for which these students are in the UK, necessitating concerted interventions. The combined effect of acculturative stress as well as anxiety to excel academically may explain the poor sleep quality within this sample (Brown, 2008; Smith & Khawaja, 2011). Some participants indicated that 'overthinking' and 'worry over studies' was a restlessness they encountered during sleep. Poor sleep quantity/quality has also been associated with lack of physical activity (Patel & Hu, 2008),

although the positive association observed in this study was not strong and not statistically significant.

Participants had normal mean BMI, as well as, stratified by gender, normal mean waist circumferences. Previous studies have reported perceived weight gain among such students living away from home country (Papadaki & Scott, 2002), owing to less healthy changes made to their diets. This study however did not assess perceived weight gain among students. The corresponding decrease in BMI with an increase in MEDAS-14 score observed within this sample portrays how the dietary pattern of students may influence adiposity, and a similar observation was made for physical activity and BMI. The lower mean BMI among female students compared to males may be due to the fact that females are more cautious about their weight (Wardle et al., 2004).

In interpreting the findings of this study, it must be noted that most of the students assessed were within the tenth month of living and studying in the UK, hence it is plausible that marginal changes in lifestyles were observed since acculturation usually occurs over significant periods (Berry, Phinney, Sam, & Vedder, 2006). Studying overseas can take up to four years, a PhD programme for example, indicating that the changes may become more prominent in the longer term. It is therefore important to look beyond statistical significance of some of the findings in this study.

5. Limitations of the study

This study involved an ethnically diverse group of international students, and visual aids on serving sizes ensured that participants estimated their dietary intake fairly consistently and accurately. Because of the cross-sectional design and exploratory nature of this study, causality

cannot be inferred and caution should be taken in projecting the findings to larger contexts. Also, the study sample was predominately female (77.3%) hence findings may be less generalizable to male students. Although this study highlighted sleep-related problems, a largely unidentified public health issue among this population, the measurement of sleep quality, for which more robust and accurate measurement forms such as actigraphy exist (Lockley, Skene, & Arendt, 1999), was based on self-reporting. Objective evaluation of sleep quality is nonetheless difficult and also costly, especially in the absence of funding (Muzet, 2007). Likewise, significant limitations pertain to self-reported measures of both PA (Sallis & Saelens, 2000) and dietary intake (Subar et al., 2003). Self-reported weight and height may have been under-reported and over-reported respectively (Connor Gorber, Tremblay, Moher, & Gorber, 2007). Finally, this study acknowledges the possibility of recall bias due to the reliance on retrospective memory associated with participants having to provide certain information based on previous events (Choi & Pak, 2005). This bias is however expected to be minimal within this sample compared to individuals such as the aged (Bhandari & Wagner, 2006).

6. Conclusion

In conclusion, insights have been provided into changes in the nutritional and other health behaviours of students who travel to study overseas. The findings of this study have implications for the provision of support for international students by University authorities to enable these students adjust more healthily upon commencement of their studies in the UK. Further qualitative studies to examine the factors influencing lifestyle habits among international students would provide relevant ideas on how such health promotion efforts can be tailored.

How the associations may hold over longer periods is crucial, hence further longitudinal studies would be highly beneficial.

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Appendix

14-item Questionnaire of Mediterranean Diet Adherence Screener

For each question, please provide the most accurate answer by either checking the box or by stating the number times (e.g. How many teaspoons of sugar do you consume per day? 5). Please click [here](#) for guide on serving sizes.

1. Do you use olive oil as culinary fat?	Yes <input type="checkbox"/> No <input type="checkbox"/>
2. How many tablespoons of olive oil do you consume in a given day (including oil used for frying, salads, out-of-house meals, etc.)?	
3. How many vegetable servings do you consume per day? (1 serving=200g). Consider side dishes as half a serving or a cereal bowl of salad as one serving. Refer to link	
4. How many fruit units (including natural fruit juices) do you consume per day? Please refer to link	
5. How many servings of red meat, hamburger, or red meat products (ham, sausage, etc.) do you consume per day? (1serving: 100-150g) Please refer to link.	
6. How many servings of butter, margarine, or cream do you consume per day? (1 serving: 12g) [12g≈ 1 tablespoon] Please refer to link	
7. How many sweet or carbonated beverages do you drink per day?	
8. How much wine do you drink per week? (number of glasses) Please refer to link	
9. How many servings of legumes do you consume per week? (1 serving=150g or ≈40 teaspoons) Please refer to link	
10. How many servings of fish or shellfish do you consume per week? (1 serving= 100-150g of fish or 200g of shellfish) Please refer to link.	
11. How many times per week do you consume commercial sweets or pastries (not homemade), such as cakes, cookies, biscuits, or custard?	
12. How many servings of nuts (including peanuts) do you consume per week? (1 serving=30g or ≈7 teaspoons) Please refer to link	
13. Do you preferentially consume chicken, turkey, or rabbit meat instead of veal, pork, hamburger, or sausage?	Yes <input type="checkbox"/> No <input type="checkbox"/>
14. How many times per week do you consume vegetables, pasta, rice or other dishes seasoned with sauce made with tomato and onion, leek, or garlic and simmered with olive oil?	

The Mediterranean Diet Score Tool

How often do you consume	Frequency of consumption (servings per week or otherwise stated)					
Non-refined cereals (whole grain bread, pasta, rice, etc)	Never <input type="checkbox"/>	1-6 <input type="checkbox"/>	7-12 <input type="checkbox"/>	13-18 <input type="checkbox"/>	19-31 <input type="checkbox"/>	> 32 <input type="checkbox"/>
Potatoes	Never <input type="checkbox"/>	1-4 <input type="checkbox"/>	5-8 <input type="checkbox"/>	9-12 <input type="checkbox"/>	13-18 <input type="checkbox"/>	> 18 <input type="checkbox"/>
Fruits	Never <input type="checkbox"/>	1-4 <input type="checkbox"/>	5-8 <input type="checkbox"/>	9-15 <input type="checkbox"/>	16-21 <input type="checkbox"/>	>22 <input type="checkbox"/>
Vegetables	Never <input type="checkbox"/>	1-6 <input type="checkbox"/>	7-12 <input type="checkbox"/>	13-20 <input type="checkbox"/>	21-32 <input type="checkbox"/>	> 33 <input type="checkbox"/>
Legumes	Never <input type="checkbox"/>	< 1 <input type="checkbox"/>	1-2 <input type="checkbox"/>	3-4 <input type="checkbox"/>	5-6 <input type="checkbox"/>	> 6 <input type="checkbox"/>
Fish	Never <input type="checkbox"/>	< 1 <input type="checkbox"/>	1-2 <input type="checkbox"/>	3-4 <input type="checkbox"/>	5-6 <input type="checkbox"/>	> 6 <input type="checkbox"/>
Red meat	≤ 1 <input type="checkbox"/>	2-3 <input type="checkbox"/>	4-5 <input type="checkbox"/>	6-7 <input type="checkbox"/>	8-10 <input type="checkbox"/>	>10 <input type="checkbox"/>
Poultry	≤ 3 <input type="checkbox"/>	4-5 <input type="checkbox"/>	5-6 <input type="checkbox"/>	7-8 <input type="checkbox"/>	9-10 <input type="checkbox"/>	>10 <input type="checkbox"/>
Full fat dairy products (cheese, yoghurt, milk)	≤ 10 <input type="checkbox"/>	11-15 <input type="checkbox"/>	16-20 <input type="checkbox"/>	21-28 <input type="checkbox"/>	29-30 <input type="checkbox"/>	> 30 <input type="checkbox"/>
Use of olive oil in cooking (times/week)	Never <input type="checkbox"/>	Rare <input type="checkbox"/>	< 1 <input type="checkbox"/>	1-3 <input type="checkbox"/>	3-5 <input type="checkbox"/>	Daily <input type="checkbox"/>
Alcoholic beverages (ml/day, 100 ml=12g ethanol)	< 300 <input type="checkbox"/>	300 <input type="checkbox"/>	400 <input type="checkbox"/>	500 <input type="checkbox"/>	600 <input type="checkbox"/>	> 700 or 0 <input type="checkbox"/>

Baecke Habitual Physical Activity Questionnaire

Sport Index

1. Do you play sports?

Yes	<input type="checkbox"/>
No	<input type="checkbox"/>

If you answered 'Yes' to question one, kindly state which sport you frequently play. _____

2. In comparison to others of my own age, I think my physical activity during leisure time is...

Much more	<input type="checkbox"/>
More	<input type="checkbox"/>
The same	<input type="checkbox"/>
Less	<input type="checkbox"/>
Much less	<input type="checkbox"/>

3. During leisure time I sweat

Very often	<input type="checkbox"/>
Often	<input type="checkbox"/>
Sometimes	<input type="checkbox"/>
Seldom	<input type="checkbox"/>
Never	<input type="checkbox"/>

4. During leisure time I play sport

Never	<input type="checkbox"/>
Seldom	<input type="checkbox"/>
Sometimes	<input type="checkbox"/>
Often	<input type="checkbox"/>
Very often	<input type="checkbox"/>

5. How many hours do you play a week?

< 1 hour	<input type="checkbox"/>
1-2 hours	<input type="checkbox"/>
2-3 hours	<input type="checkbox"/>
3-4 hours	<input type="checkbox"/>
>4 hours	<input type="checkbox"/>

6. How many months do you play in a year?

< 1 month	<input type="checkbox"/>
1-3 months	<input type="checkbox"/>
4-6 months	<input type="checkbox"/>
7-9 months	<input type="checkbox"/>
> 9 months	<input type="checkbox"/>

Leisure Index

1. During leisure time I watch videos on television, laptop, phone, etc. or surf social media

Never	<input type="checkbox"/>
Seldom	<input type="checkbox"/>
Sometimes	<input type="checkbox"/>
Often	<input type="checkbox"/>
Very often	<input type="checkbox"/>

2. During leisure time I walk

Never	<input type="checkbox"/>
Seldom	<input type="checkbox"/>
Sometimes	<input type="checkbox"/>
Often	<input type="checkbox"/>
Very often	<input type="checkbox"/>

3. During leisure time I cycle

Very often	<input type="checkbox"/>
Often	<input type="checkbox"/>
Sometimes	<input type="checkbox"/>
Seldom	<input type="checkbox"/>
never	<input type="checkbox"/>

4. How many minutes do you walk and/or cycle per day to and from work, school or shopping?

< 5 minutes	<input type="checkbox"/>
5-15 minutes	<input type="checkbox"/>
15-30 minutes	<input type="checkbox"/>
30-45 minutes	<input type="checkbox"/>
> 45 minutes	<input type="checkbox"/>

Pittsburgh sleep quality index

INSTRUCTIONS: The following questions relate to your usual sleep habits during the **past month only**. Your answers should indicate the most accurate reply for the majority of days and nights in the past month. Please answer all questions.

1. During the past month, when have you usually gone to bed at night?

USUAL BED TIME:

2. During the past month, how long (in minutes) has it usually take you to fall asleep each night?

NUMBER OF MINUTES:

3. During the past month, when have you usually gotten up in the morning?

USUAL GETTING UP TIME:

4. During the past month, how many hours of actual sleep did you get at night? (This may be different than the number of hours you spend in bed.)

HOURS OF SLEEP PER NIGHT:

INSTRUCTIONS: For each of the remaining questions, check the one best response. Please answer all questions.

5. During the **past month**, how often have you had trouble sleeping because you...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Cannot get to sleep within 30 minutes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Wake up in the middle of the night or early in the morning	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Have to get up to use the bathroom	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Cannot breathe comfortably	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Cough or snore loudly	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
f. Feel too cold	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
g. Feel too hot	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
h. Had bad dreams	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
i. Have pain	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
j. Other reason(s), please describe				
k. How often during the past month have you had trouble sleeping because of the reason described in 'j'	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Very good	Fairly good	Fairly bad	very bad
6. During the past month, how would you rate your overall sleep quality overall?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
7. During the past month, how often have you taken medicine (prescribed or "over the counter") to help you sleep?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
8. During the past month, how often have you had trouble staying awake while driving, eating meals, or engaging in social activity	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	No problem at all	Only a very slight problem	Somewhat of a problem	A very big problem
9. During the past month, how much of a problem has it been for you to keep up enough enthusiasm to get things done?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

	No bed partner or roommate	Partner/roommate in other room	Partner in same room, but not same bed	Partner in same bed
10. Do you have a bed partner or roommate?	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

If you have a roommate or bed partner, ask him/her how often in the past month you have had ...

	Not during the past month	Less than once a week	Once or twice a week	Three or more times a week
a. Loud snoring	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
b. Long pauses between breaths while asleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
c. Legs twitching or jerking while you sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
d. Episodes of disorientation or confusion during sleep	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
e. Other restlessness while you sleep; please describe below	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

Participant information

Age:

Sex: Male ☐ Female ☐

Nationality:

Course of study: BA/BSc
MPhil/PhD/ProfDoc

MSc/MA/MBA

Year of study:

Do you smoke? Yes ☐ No ☐

Do you drink alcohol? Yes ☐ No ☐

Please record your...

Height (m):

Weight (kg):

Waist circumference (cm): (wrap tape measure around your waist on the belly button, as shown in the figure below)



How to measure waist circumference

Investigating the changes in dietary habits, physical activity, and sleep quality in relation to body composition indices among a cross-section of international students in the University of Chester

You are being invited to take part in a research study. Before you decide, it is important for you to understand why the research is being done and what it will involve. Please take time to read the following information carefully and discuss it with others if you wish. Ask us if there is anything that is not clear or if you would like more information. Take time to decide whether or not you wish to take part.

Thank you for reading this.

What is the purpose of the study?

This research is being undertaken among international students in the University of Chester. The project is to find out, if any at all, changes in the dietary habits, levels of physical activity and also sleep quality in relation to body composition indices among international students at the University of Chester.

This study will inform about changes in key health lifestyle factors and thus help the implementation of future strategies aimed at ensuring that international students do not only receive high quality education at the University of Chester, but are also living healthily during the course of their studies.

Why have I been chosen?

You have been chosen because you are an international student at the University of Chester.

Do I have to take part?

It is up to you to decide whether or not to take part. If you decide to take part, you will be given this information sheet to keep and be asked to sign a consent form. If you decide to take part you are still free to withdraw at any time and without giving a reason. A decision to withdraw at any time, or a decision not to take part, will not affect you in any way.

What will happen to me if I take part?

You will be required to complete a set of four questionnaires. Two of the questionnaires would be completed twice; based on your experience before and after arrival in the UK. This is estimated to take an estimated 120 minutes to complete. You will also provide information about your weight (in kilograms), your height (in meters) as well as your waist circumference (in centimetres).

What are the possible disadvantages and risks of taking part?

There are no disadvantages or potential risks to your participation in this study.

What are the possible benefits of taking part?

After your participation in this research, you will be provided with details of your body mass index, visceral fat and total body fat all of which are important health indicators, and also benefit from nutritional, physical activity and sleep assessment.

What if something goes wrong?

If you wish to complain or have any concerns about any aspect of the way you have been approached or treated during the course of this study, please contact Dean of the Faculty of Medicine, Dentistry & Clinical Sciences, University of Chester, Parkgate Road, Chester, CH1 4BJ, 01244 510000

Will my taking part in the study be kept confidential?

All information which is collected about you during the course of the research will be kept strictly confidential so that only the researcher carrying out the research will have access to such information.

Participants should note that data collected from this project may be retained and published in an anonymised form. By agreeing to participate in this project, you are consenting to the retention and publication of data.

What will happen to the results of the research study?

The results will be written up into a dissertation for my final project of my MSc. Individuals who participate will not be identified in any subsequent report or publication.

Who is organising the research?

The research is conducted as part of an MSc in Public Health Nutrition within the Department of Clinical Sciences & Nutrition at the University of Chester. The study is organised with supervision from the department, by Solomon Sowah, an MSc student.

Who may I contact for further information?

If you would like more information about the research before you decide whether or not you would be willing to take part, please contact:

Solomon Sowah. 1520634@chester.ac.uk

Thank you for your interest in this research.



**Faculty of Medicine, Dentistry and Clinical Sciences
Research Ethics Committee**

frec@chester.ac.uk

28/04/2016

Solomon Adjetey Sowah
University of Chester

Dear Solomon

Study title: *Differentiating between the effect of living away from home for the first time on the diet, physical activity level and sleep quantity/quality of international students studying in Chester UK.*

FREC reference: *1149/16/SAS/CSN*

Version number: *1*

Thank you for providing the documentation for the amendments recommended following the approval of the above application. These amendments have been approved by the Faculty Research Ethics Committee.

- Specifying clothing for participants.

With the Committee's best wishes for the success of this project.

Yours sincerely,

A handwritten signature in black ink, appearing to read 'Ben Green', with a long horizontal flourish extending to the right.

Professor Ben Green
Chair, Faculty Research Ethics Committee